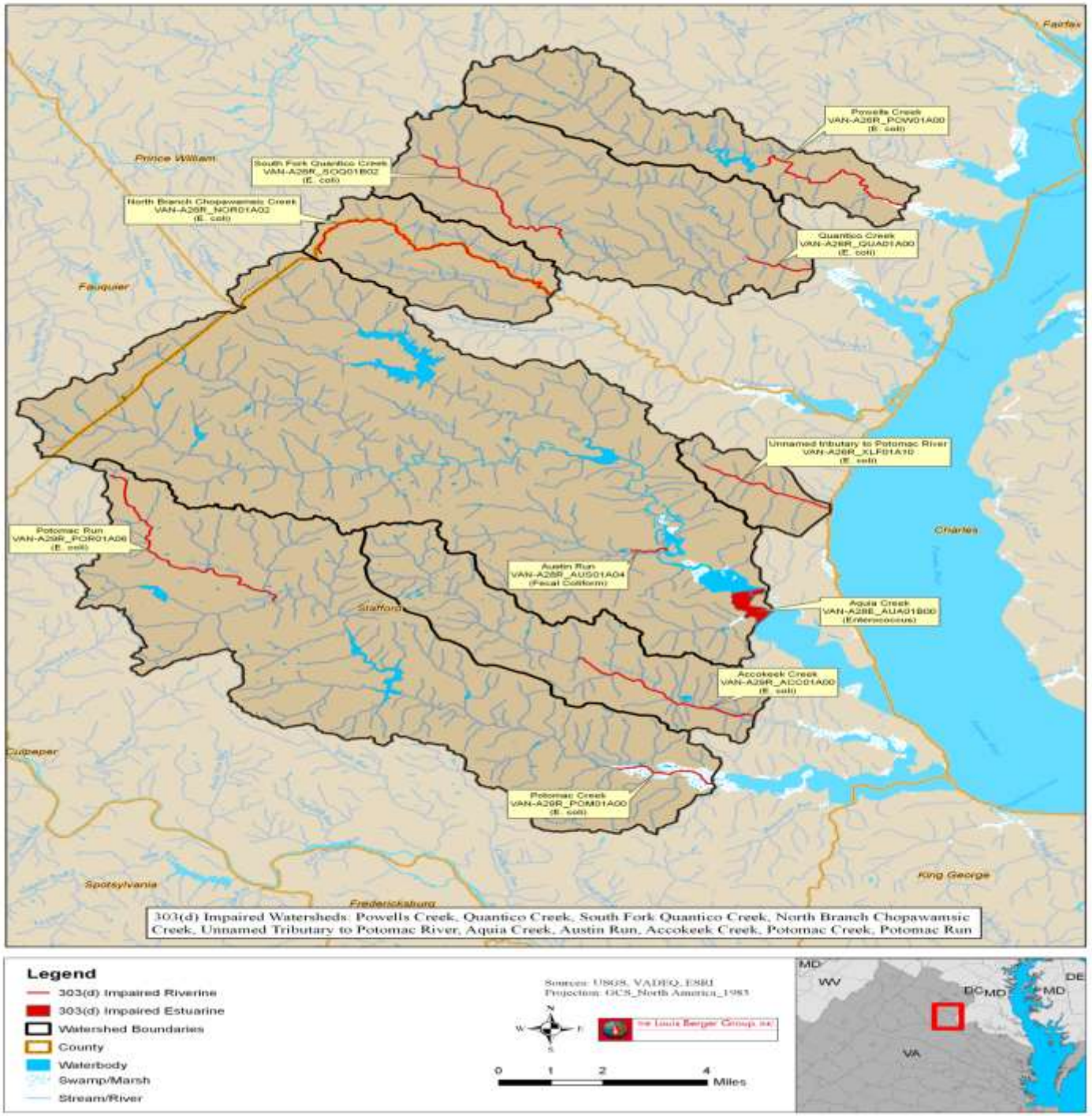
Bacteria Total Maximum Daily Load Studies for Tributaries to the Potomac River: Prince William and Stafford Counties

Technical Advisory Committee Meeting #2
September 19, 2011

Meeting Agenda

- **Project Background and Updates** (*DEQ*)
- **Technical Approach** (*Louis Berger Group and DEQ*)
  - **Land Use**
  - **Source Assessment**
  - **Modeling Framework**
  - **Other Issues**
- **Next Steps** (*DEQ*)
- **Questions**


Fairfax
Prince William
Powells Creek
VAN-A26R_POW01A00
(E. coli)
South Fork Quantico Creek
VAN-A26R_SOQ01B02
(E. coli)
North Branch Chopawamsic Creek
VAN-A26R_NOR01A02
(E. coli)
Quantico Creek
VAN-A26R_QUA01A00
(E. coli)
Fauquier
Unnamed tributary to Potomac River
VAN-A26R_XLP01A10
(E. coli)
Charles
Potomac Run
VAN-A29R_POR01A06
(E. coli)
Austin Run
VAN-A29R_AUS01A04
(Fecal Coliform)
Stafford
Aquia Creek
VAN-A28E_AUA01B00
(Enterococcus)
Accokeek Creek
VAN-A29R_ACC01A00
(E. coli)
Culpeper
Potomac Creek
VAN-A29R_POM01A00
(E. coli)
Spotsylvania
Fredericksburg
King George
303(d) Impaired Watersheds: Powells Creek, Quantico Creek, South Fork Quantico Creek, North Branch Chopawamsic Creek, Unnamed Tributary to Potomac River, Aquia Creek, Austin Run, Accokeek Creek, Potomac Creek, Potomac Run
Legend
303(d) Impaired Riverine
303(d) Impaired Estuarine
Watershed Boundaries
County
Waterbody
Swamp/Marsh
Stream/River
Sources: USGS, VADEQ, ESRI
Projection: GCS_North_America_1983
The Louis Berger Group, Inc.
0 1 2 4
Miles
MD
WV
DC
MD
DE
MD
VA

Waterbody Name *Location*	**Segment Size**	**Cause**	**Upstream Limit**	**Downstream Limit**	**DEQ Monitoring Station(s)** *Station Location*	**Year First Listed as Impaired**	**2010 Exceedance Rate**
Powells Creek *Prince William County*	4.62 miles	*E. coli*	0.2 rivermiles below Lake Montclair	End of the free-flowing waters	**1aPOW006.11** *Northgate Drive Bridge Crossing*	2006	2 of 13 samples (15.4%)
Quantico Creek *Prince William County Town of Dumfries*	1.45 miles	*E. coli*	Confluence with South Fork Quantico Creek	Start of the tidal waters of Quantico Bay.	**1aQUA004.46** *Route 1 Bridge Crossing*	2006	7 of 27 samples (25.9%)
South Fork Quantico Creek *Prince William County Town of Dumfries*	4.63 miles	*E. coli*	Headwaters of the South Fork Quantico Creek	Start of the impounded waters	**USGS Station 01658500**	2004	7 of 47 samples (14.9%)
North Branch Chopawamsic Creek *Stafford County Prince William County*	6.9 miles	*E. coli*	Headwaters of North Branch Chopawamsic Creek	Confluence with Middle Branch	**USGS Station 01659000**	2004	2 of 17 samples (11.7%)
Unnamed Tributary to the Potomac River *Stafford County*	2.9 miles	*E. coli*	Headwaters of the unnamed tributary	Confluence with the Potomac River	**1aXLF000.13** *Route 633 Bridge Crossing*	2010	2 of 11 samples (18.2%)

Waterbody Name *Location*	**Segment Size**	**Cause**	**Upstream Limit**	**Downstream Limit**	**DEQ Monitoring Station(s)** *Station Location*	**Year First Listed as Impaired**	**2010 Exceedance Rate**
Aquia Creek *Fauquier County Stafford County*	0.3638 mi^2	Enterococcus	Rivermile 4.28	Rivermile 3.28	**1aAUA003.71** *Railroad Bridge Crossing*	2008	5 of 38 samples (13.2%)
Austin Run *Fauquier County Stafford County*	0.79 miles	Fecal Coliform	Confluence with an unnamed tributary (streamcode XGQ)	Confluence with Aquia Creek	**1aAUS000.49** *End of Aquia Drive*	2004	3 of 8 samples (37.5%)
Accokeek Creek *Stafford County*	4.21 miles	*E. coli*	Confluence with an unnamed tributary	End of the free-flowing waters	**1aACC006.13** *Route 608 Bridge Crossing*	2006**	4 of 23 samples (17.4%)
Potomac Creek *Stafford County*	2.18 miles	*E. coli*	Railroad crossing at the west end of swamp, upstream from Route 608	Downstream until the east end of swamp	**1aPOM006.72** Route 608 Bridge Crossing	2006*	4 of 13 samples (30.8%)
Potomac Run *Stafford County*	6.13 miles	*E. coli*	Headwaters of Potomac Run	Confluence with Long Branch	**1aPOR000.40** (Route 648 Bridge Crossing)	2006	10 of 13 samples (76.9%)

Project Update

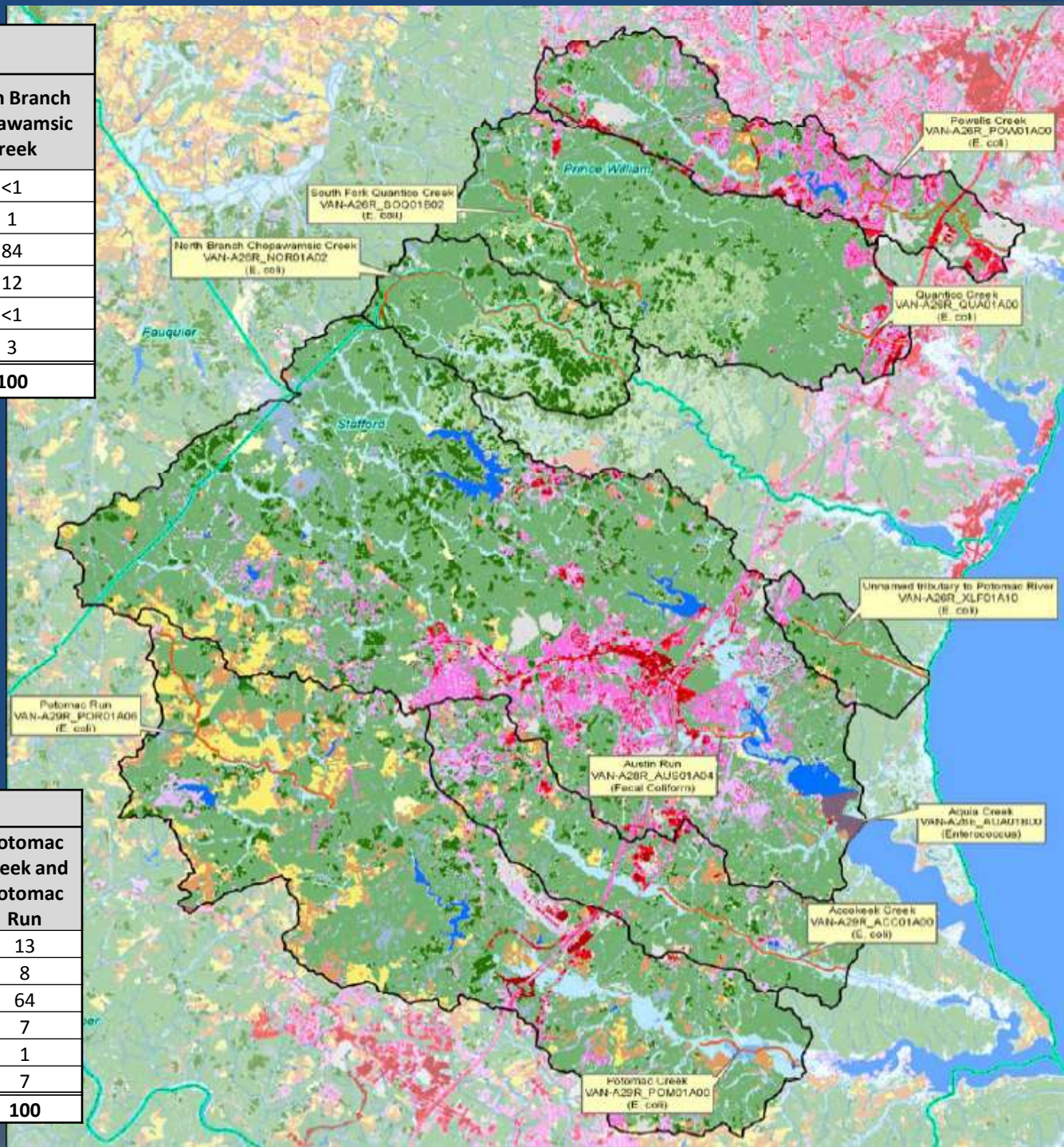
- Public Meetings held April 19 and 20, 2011
- May – July: Worked on Source Assessment
- TAC Review of Source Assessment:
  August 18, 2011 – September 9, 2011

Technical Approach

- Land Use
- Source Assessment
- Modeling Framework
- MS4 Permits

Percent of Watershed			
General Land Use Category	Powells Creek	South Fork Quantico Creek	North Branch Chopawamsic Creek
Developed	31	7	<1
Agricultural	5	<1	1
Forested	47	85	84
Wetland	5	5	12
Water	1	<1	<1
Other	11	3	3
Total:	**100**	**100**	**100**

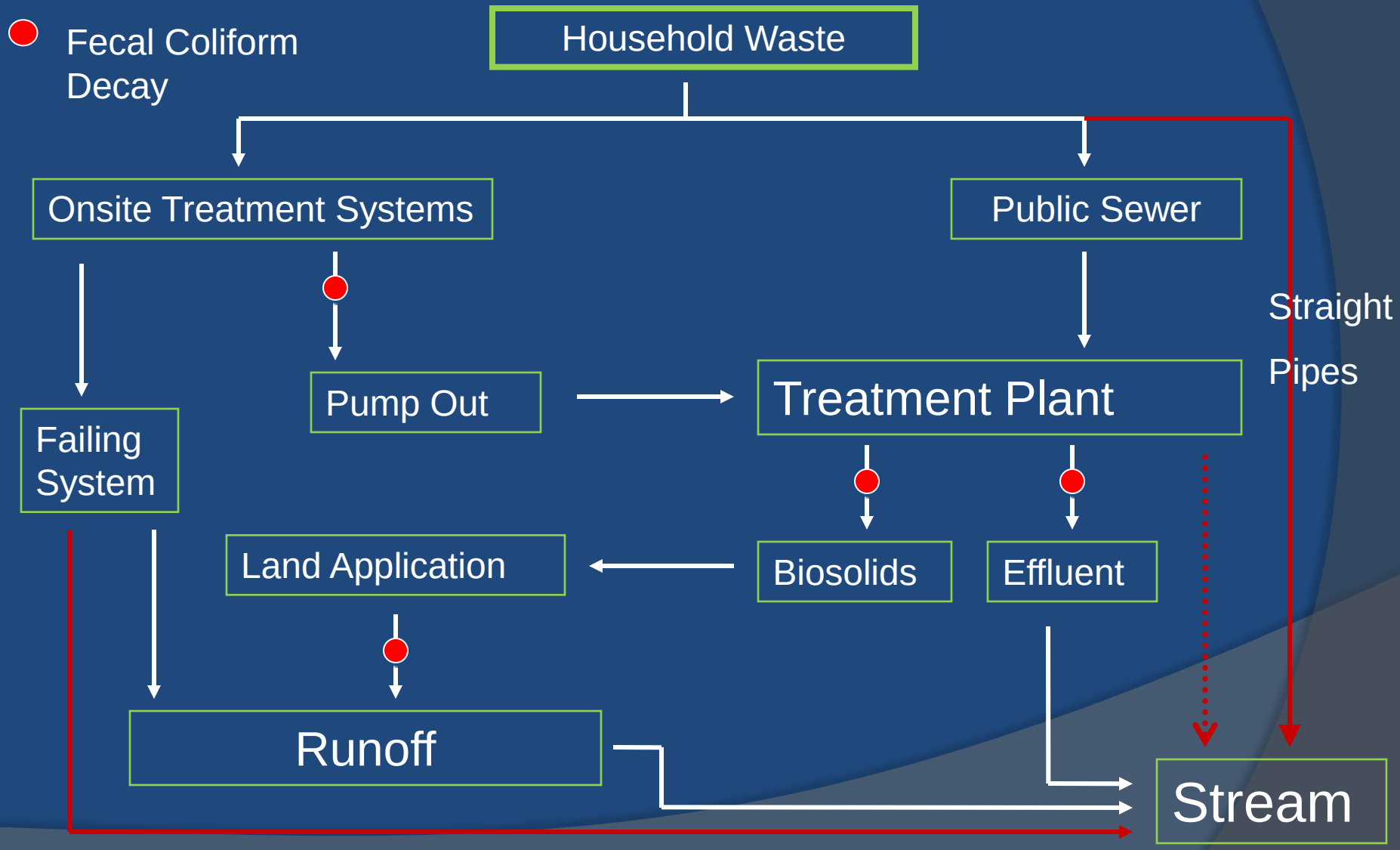
Percent of Watershed				
General Land Use Category	UT to Potomac River	Aquia Creek and Austin Run	Accokeek Creek	Potomac Creek and Potomac Run
Developed	9	17	13	13
Agricultural	3	5	8	8
Forested	77	61	63	64
Wetland	6	7	8	7
Water	0	2	<1	1
Other	5	8	8	7
Total:	**100**	**100**	**100**	**100**



Bacteria Source Assessment

- Inventory of potential bacteria sources in the watershed:
  - Human
  - Wildlife
  - Livestock
  - Pets
- Data Sources:
  - Local Experts (Local Governments, TAC, SWCDs, Health Department, etc.)
  - Census Data (Agricultural Census and US Census)
  - Literature Studies

Bacteria From Human Sources



Population Estimates

- Based on 2009 United States Census Data and Stakeholder Input.
- Sewage Disposal Methods:
  - Sewer Systems (predominantly cities)
  - Septic Systems
    - Failure rates can range between 3 and 40%. 3% Failure rate used for this project.
  - Other Systems (assumed to be no waste management, or “straight pipe”)
- Failing septic systems and straight pipes near stream channels can contribute significant sewage. For this TMDL Study area:
  - Approximately 1,451 septic systems are failing within 200 ft of streams
  - Approximately 439 straight pipes discharge within 200 ft of streams

Estimates of Failing Septic Systems and Straight Pipes by Impaired Watershed

Impaired Watershed	Failing Septic Systems[1]	Straight Pipes[2]
Powells Creek	41	37
Quantico Creek/South Fork Quantico Creek	15	14
North Branch Chopawamsic Creek	0	0
Unnamed Tributary to Potomac River	5	7
Aquia Creek/Austin Run	227	287
Accokeek Creek	33	42
Potomac Creek/Potomac Run	41	52

[1]Based on a septic failure rate of 3% (VA DEQ)

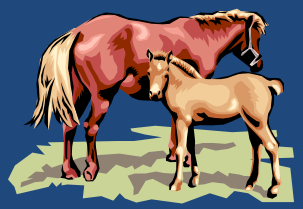
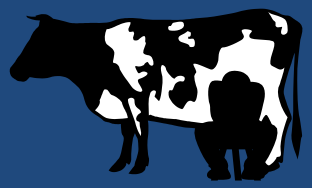
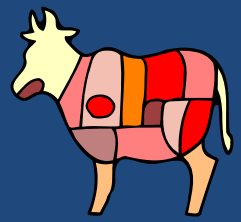
[2]Based on 2009 census estimate

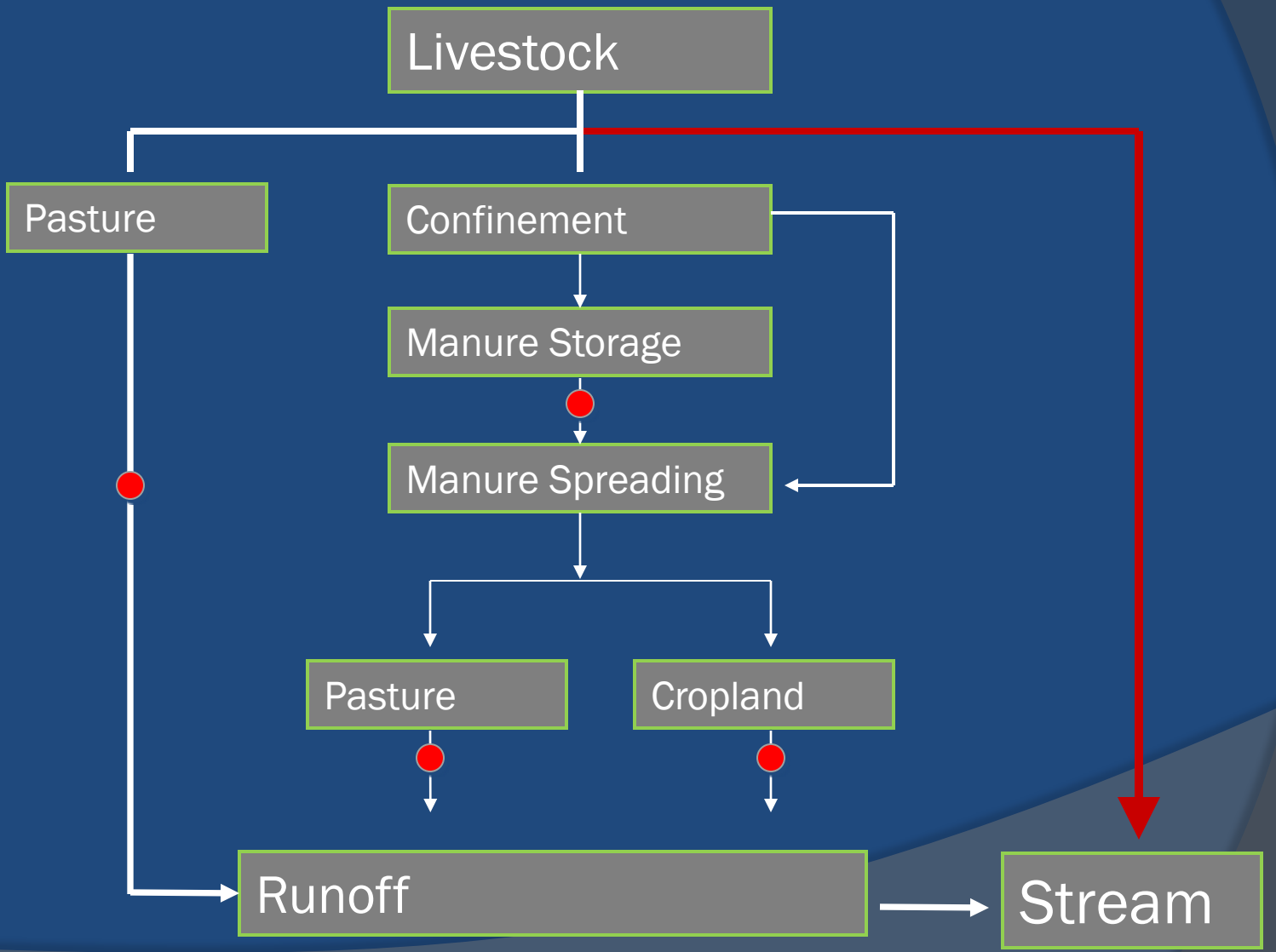
Point Source* Inventory

Permit Number	Facility Name	Watershed	VPDES Permit Type	Maximum Permitted Design Flow (MGD)	Permit Limit for *E. coli* bacteria (cfu/100mL)
VA0091774	Trzicak STP	Aquia Creek/ Austin Run	Individual Municipal Permit	0.001	126
VA0092479	Abrahms Ct STP	Aquia Creek/ Austin Run	Individual Municipal Permit	0.0036	126
VA0060968	Aquia Wastewater Treatment Plant	Aquia Creek/ Austin Run	Individual Municipal Permit	12	126
VA0089630	Randall STP	Accokeek Creek	Individual Municipal Permit	0.0008	126
VAG406114	Residence	Unnamed Tributary to Potomac River	General Permit – Domestic Sewage	0.001	126
VAG406207	Residence	Accokeek Creek	General Permit – Domestic Sewage	0.001	126

Permit Number	MS4 Permit Holder
VAR040056	Stafford County
VAR040069	United States Marine Corps, Quantico
VAR040071	Stafford County Public Schools
VAR040100	Prince William County Public Schools
VAR040115	Virginia Department of Transportation
VAR040117	Town of Dumfries
VA0088595	Prince William County

Only permits that are expected to discharge the pollutant of concern (bacteria) are presented on this slide.


Livestock
Pasture
Confinement
Manure Storage
Manure Spreading
Pasture
Cropland
Runoff
Stream
Fecal Coliform Decay

Livestock Estimation:

- Total # of livestock and total number of pastureland acres in counties obtained from the United States Department of Agriculture (USDA) 2007 Agricultural Census*
- Total amount of pastureland in each impaired watershed calculated via GIS (NLCD 2006 land cover)
- Ratio of watershed area to county area applied to livestock #s

Example Using Hypothetical Numbers:

$$\frac{\text{Acres of Pastureland in Impaired Watershed}^{*}}{\text{Acres of Pastureland in County}^{\#}} = \frac{\text{Number of Horses in Impaired Watershed}}{\text{Number of Horses in County}^{\#}}$$

$$\frac{20 \text{ acres}}{100 \text{ acres}} = \frac{X}{50 \text{ horses}}$$

$$X = 10 \text{ horses}$$

**Obtained from NLCD Land Use GIS Layer*
 # Obtained from the 2007 Agricultural Census

***(http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp).**

Livestock Estimates* by County:

Livestock Type	Prince William	Stafford	Fauquier
Beef cows	1,373	1,164	19,060
Milk cows	840	4,086	25
Other Cattle	2,026	1,338	21,008
Hogs and pigs inventory	20	21	312
Sheep and lambs inventory	594	845	5
Chickens	0	0	475
Chickens (Layers)	687	951	3,571
Turkeys	6	0	59
Horses and ponies, inventory	1,833	593	5,941

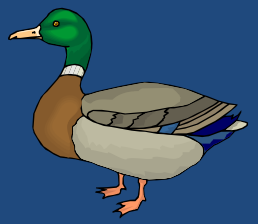
**Livestock numbers are based on the 2007 US Agricultural Census data*

Livestock Estimates by Impaired Watershed:

Livestock Animal	Powells Creek[1]	Quantico Creek/South Fork Quantico Creek[1]	North Branch Chopawamsic Creek[1,2]	Unnamed Tributary to Potomac River[2]	Aquia Creek/Austin Run[2]	Accokeek Creek[2]	Potomac Creek/Potomac Run[2]
Beef Cows	30	5	0	5	250	50	350
Milk Cows	20	0	0	0	25	0	0
Other Cattle	45	5	0	5	280	60	400
Hogs & Pigs	0	0	0	0	10	0	10
Sheep & Lambs	15	5	0	0	10	0	10
Chickens	0	0	0	0	5	0	0
Chickens (Layers)	0	0	0	0	5	0	0
Turkeys	0	0	0	0	0	0	0
Horses & Ponies	140	0	0	0	105	30	180

[1] *Based on USDA 2007 Agricultural Census Data (http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp)*

[2] *Based on input from Prince William County and USDA 2007 Agricultural Census Data*



Wildlife

Pasture

Cropland

Forest

Built-up area

Runoff

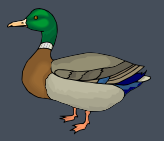
Stream

Fecal Coliform Decay

Wildlife Densities

Wildlife Type	Habitat Requirements	Animal Density per Acre of Habitat
Deer	Entire watershed	0.12 animals/acre
Raccoon	Entire watershed	0.31 animals/acre
Muskrat	Within 60 feet of streams and ponds (urban, grassland, forest, wetlands)	0.23 animals/acre
Beaver	Within 66 feet of streams and ponds	4.8 animals/acre
Goose-Summer	Within 300 feet of streams and ponds (urban, grassland, wetlands)	2.34 animals/acre
Goose-winter	Within 300 feet of streams and ponds (urban, grassland, wetlands)	2.50 animals/acre
Duck- Summer	Within 300 feet of streams and ponds (urban, grassland wetlands, forest)	0.06 animals/acre
Duck- Winter	Within 300 feet of streams and ponds (urban, grassland wetlands, forest)	0.37 animals/acre
Turkey	Entire watershed excluding urban land uses	0.01 animals/acre

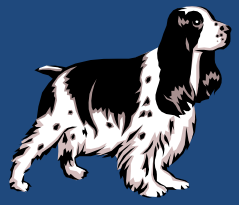
[1] *Source: Difficult Run Bacteria TMDL Report (VA DEQ), Department of Game and Inland Fisheries (DGIF)*



Wildlife Estimates by Impaired Watershed

Wildlife Animal	Powells Creek	Quantico Creek/South Fork Quantico Creek	North Branch Chopawamsic Creek	Unnamed Tributary to Potomac River	Aquia Creek/Austin Run	Acookeek Creek	Potomac Creek/Potomac Run
Deer	1,169	2,081	842	326	6,244	1,340	3,889
Raccoon	3,019	5,375	2,175	841	16,130	3,461	10,046
Muskrat	95	209	81	32	569	156	342
Beaver	2,552	4,905	1,870	752	15,249	3,887	9,597
Goose – Summer	2,068	1,761	1,395	410	10,532	2,475	5,377
Goose – Winter	2,209	1,881	1,491	438	11,252	2,644	5,745
Duck – Summer	126	258	100	38	768	195	446
Duck - Winter	779	1,593	615	234	4,734	1,205	2,748
Wild Turkey	66	162	70	25	424	97	300

[1] Based on densities used in the Difficult Run Bacteria TMDL Report (VA DEQ) and provided by the Department of Game and Inland Fisheries (DGIF)



Pets: Dogs & Cats

Pasture

Cropland

Forest

Built-up area

Runoff

Stream

Fecal Coliform Decay

Pet Estimates

- Pet Estimates:
- Pet inventories based on:
  - 0.632 Dogs per household*
  - 0.713 Cats per household*
- In the study area there are approximately:
  - 23,035 Dogs
  - 25,984 Cats

*AVMA, 2007

Pet Estimates by Impaired Watershed

Impaired Watershed	Cats	Dogs
Powells Creek	6,100	5,400
Quantico Creek/South Fork Quantico Creek	2,280	2,020
North Branch Chopawamsic Creek	19	17
Unnamed Tributary to Potomac River	310	275
Aquia Creek/Austin Run	13,000	11,523
Accokeek Creek	1,910	1,700
Potomac Creek/Potomac Run	2,365	2,100

Source Loading Estimates

- Determine the daily fecal coliform production by source
- Estimate the size/number of each source
- Determine whether the source is
  - Direct
  - Indirect
- Calculate the load to each land use based on a monthly schedule and for each source
- The sum of all the individual sources is the total load

Daily Fecal Coliform Production by Source

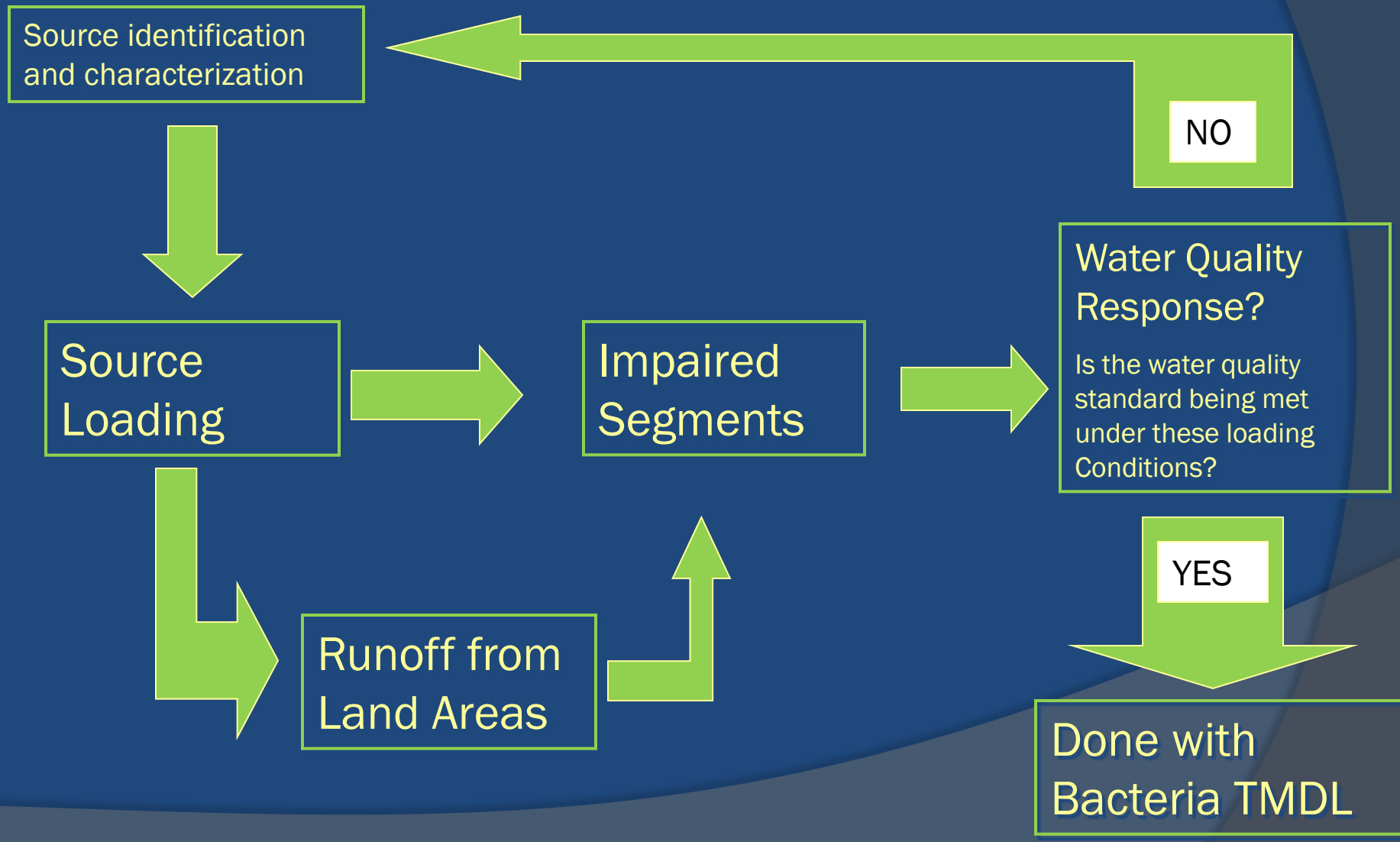
Source	Fecal Coliform Content in Fecal Matter (million) (cfu/day)
Human	1,950
Pet	450
Horse	420
Beef Cattle	33,000
Dairy-Milked or dry Cow	25,200
Dairy-Heifer	11,592
Sheep	27,000
Deer	347
Raccoon	113
Muskrat	25
Beaver	0.2
Goose	799
Duck	2,430
Mallard	2,430
Wild Turkey	93
Hog	10,800
Chicken (Layer)	136

Source	The Equivalent Number of Sources to One Beef Cow
Human	16.92
Pet	73.33
Horse	78.57
Beef Cattle	1.00
Dairy-Milked or dry Cow	1.31
Dairy-Heifer	2.85
Sheep	1.22
Deer	95.10
Raccoon	292.04
Muskrat	1,320.00
Beaver	165,000.00
Goose	41.30
Duck	13.58
Mallard	13.58
Wild Turkey	354.84
Hog	3.06
Chicken (Layer)	242.65

NOTE: The fecal coliform content is based on analysis of the fecal matter from these sources.

Sources: ASAE, Map Tech, Metcalf & Eddy,

Linking the Source to the Instream Water Quality



Water Quality Model: HSPF

Hydrologic Simulation Program Fortran

Input → Model → Output

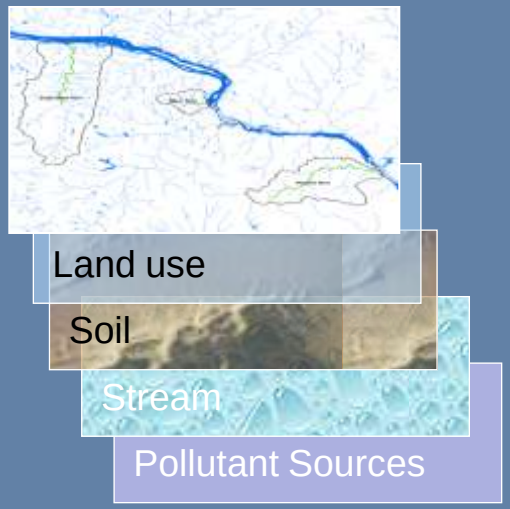
Factors:

Rainfall events

Fecal coliform build up

Fecal coliform wash off

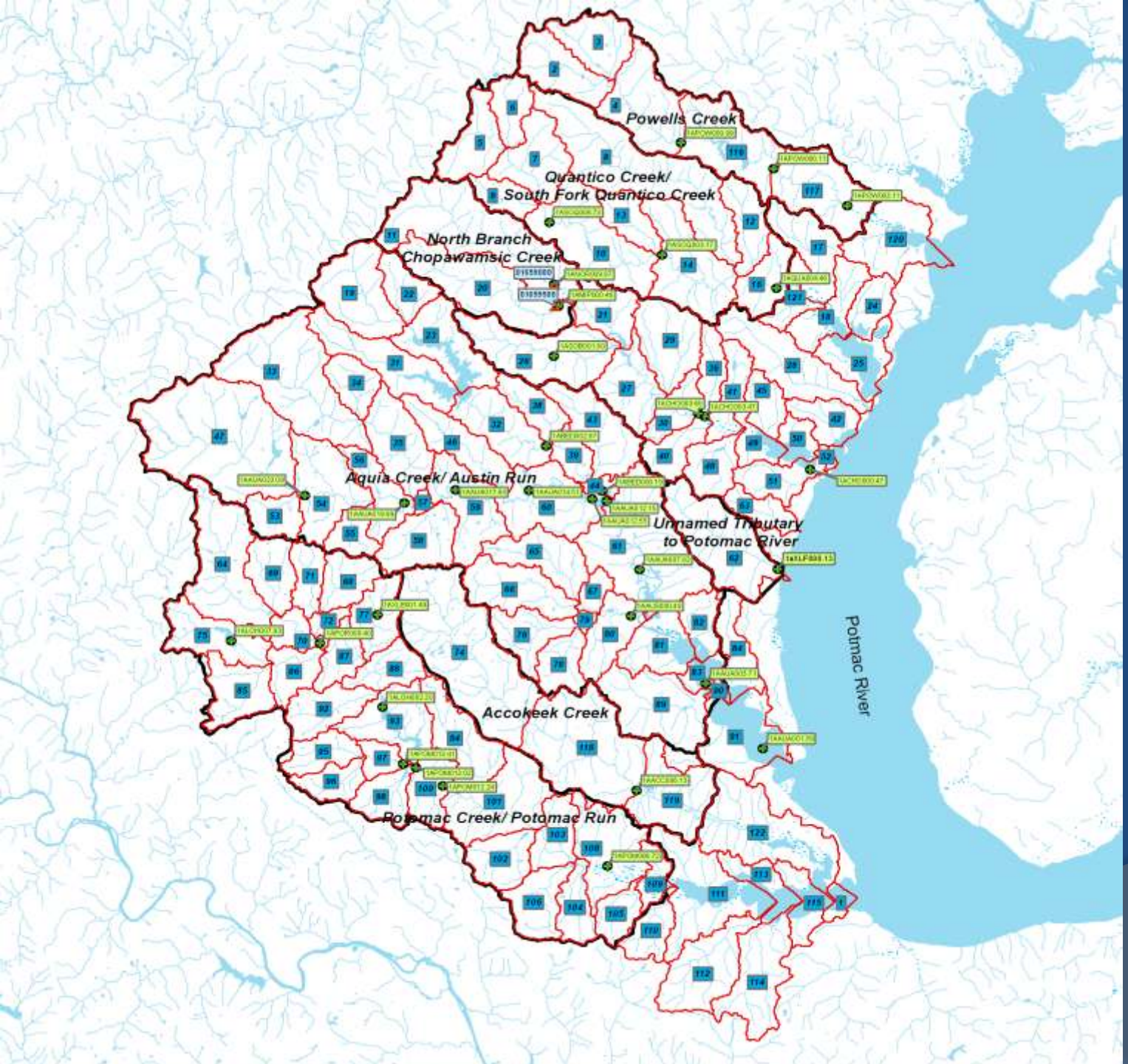
Fecal coliform die off rates



Watershed Response

HSPF Model Setup

- Drainage area delineated to 117 model segments for bacteria loadings
- Hydrologic Model Calibration/Validation
  - USGS Flow Stations:
    - 01659000 – North Branch Chopawamsic Creek
    - 01659500 – Middle Branch Chopawamsic Creek
    - 01658500 – Quantico Creek South Fork
    - 01660400 – Aquia Creek/Austin Run
- Water quality Model Calibration/Validation
  - Using DEQ water quality stations on impaired segment
- Weather data:
  - NCDC data from Dulles Airport



HSPF Modeling Segments and DEQ Monitoring Stations

MS4 Allocations

- Multiple MS4 permits in each watershed
- Approach for Assigning WLA for each permit:
  - Land Based Loads coming from urban land uses
  - Aggregated WLA by Geographical Areas

North Branch Chopawamsic Creek (A26R-04-BAC)				
Permit Number	**MS4 Permit**	**MS4 Geographical Area**	**Wasteload Allocation (cfu/day)**	**Wasteload Allocation (cfu/year)**
VA0088595	Prince William County	Prince William County	TBD	TBD
VAR040100	Prince William County Public Schools			
VAR040115	Virginia Department of Transportation			
VAR040069	United States Marine Corps, Quantico			
VAR040056	Stafford County	Stafford County	TBD	TBD
VAR040069	United States Marine Corps, Quantico			
VAR040115	Virginia Department of Transportation			
		Total MS4 WLA	**TBD**	**TBD**

Next Steps

Schedule for Project Completion

	January 2011	February 2011	March 2011	April 2011	May 2011	June 2011	July 2011	August 2011	September 2011	October 2011	November 2011	December 2011
Data Gathering	■	■	■	■								
Joint TAC Meeting			■									
First Round of Public Meetings				■								
Source Assessment				■	■	■	■	■				
Model Calibration and Validation									■	■		
Second Round of TAC Meetings									■			
Draft TMDL Allocations										■		
Third Round of TAC Meetings										■	■	
Draft TMDL Reports											■	
Final Round of Public Meetings											■	
Comment Period on Draft Report											■	■
Final Draft of Report Submitted to EPA for Approval												■

Comment Period

- **Comment Period for Materials Presented at the TAC Meeting extends from September 19, 2011 to October 19, 2011.**
- **Comments should be submitted in writing to:**

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13901 Crown Court, Woodbridge, VA 22193

Questions?

CONTACTS

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THE Louis Berger Group, INC.

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY